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Highlights of the Fifth International Congress on Nutrition

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Highlights of the Fifth International Congress on Nutrition

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INTRODUCTION

No area of research in this century has yielded so much for the benefit of man than the basic science of nutrition. For example, today in the technically developed areas of the world, deficiency diseases such as pellagra, rickets, scurvy, beri-beri and vitamin A deficiency are so rare that it is virtually impossible to find suitable cases to demonstrate to medical students. By 1950, the nutritional research biochemist through research was able to define with considerable confidence the chemical substances needed for the adequate nutrition of animals, including man. In fact, for a number of these important chemicals such as some of the vitamins, essential amino acids and minerals, fairly accurate quantitative estimates could be made in regard to their basic requirements by man. Indeed quite a remarkable achievement!

At the start of the second half of this century most, but perhaps not all, of the pieces of the jigsaw puzzle that make up our knowledge of nutrients were at hand. However, as information accumulates, new problems develop. Research into areas such as the mechanism of action of the vitamins in enzyme reactions, the influence of imbalance of nutrients on nutritional status, the role of genetic factors on nutritional requirements, and the effect of anti-vitamins on metabolism have created many new questions. There has resulted, also, an increased awareness of nutrient inter-relationships such as the conversion of tryptophan to niacin, and the function of pyridoxine in amino acid metabolism. Great advances have also shown the importance of nucleic acids, nucleoproteins and genes as determinants of growth, development and biological functions. Increasing emphasis has been placed on the application of nutrition information in the prevention and management of disease, particularly the chronic and degenerative diseases such as cardiovascular disease.

THE FIFTH INTERNATIONAL NUTRITION CONGRESS

A recent event of very great significance to nutritionists from all over the world was the Fifth International Congress on Nutrition, held September 1-7, 1960 in Washington, D.C. Representatives in nutrition from some 60 countries were in attendance. A survey of the varied program of this Congress brings into clear focus the problems of concern to nutritionists and outlines the advances made in our knowledge of nutrition. A sobering view of the challenge that lies ahead for the science of nutrition in the service of mankind was also in evidence. The importance of this Congress merits a review of some of its highlights.

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THE PRESIDENT OF THE UNITED STATES SPEAKS

A dramatic and interesting highlight of the opening session of the Congress on Nutrition was the welcome given by the President of the United States, Dwight D. Eisenhower. His brief but stimulating message emphasized the importance of improving the nutritional status of the underprivileged countries of the world. He warned, however, against overenthusiastic and indiscriminate distribution of our vast food surpluses because of the danger of disturbing the balance of world economics and causing considerable harm.

THE PROGRAM

The program of the Congress included a series of scientific sessions on subjects of current interest in nutrition. Perhaps the most interesting, provocative and best attended sessions were a series of panel discussions on: Evaluation of Nutritional Status in Man; Proteins and Amino Acids in Nutrition; Lipids in Health and Disease; Nutrition in Maternal and Infant Feeding; Effects of Processing and Additives on Foods; Animal Nutrition and Food Production; and Three Hours Around the World — New Possibilities in Nutrition Research. Those who organized and planned this Congress did an outstanding job.

EVALUATION OF NUTRITIONAL STATUS IN MAN

Great difficulties are encountered in the evaluation of the nutrition status of both a population group and an individual. Many factors influence nutritional well being such as climate, soil, agriculture, transportation, distribution, education, economics, habits, social customs and the general level of health as affected by infectious and parasitic diseases.

The Interdepartmental Committee on Nutrition for National Defense has gained considerable experience in evaluating the nutritional status of populations in some 14 countries. From its vast amount of work, methodology and technics have been developed so that now reliable comparisons of the findings within and between countries are possible.

The ICNND has concluded that a combination of approaches must be made to provide the most meaningful results. These include physical examinations, biochemical studies on blood and urine and careful dietary surveys. The ICNND does much more than just evaluate. An appraisal of the food and agriculture, the food processing capacity, the methods available for production, and the economics of the countries under study is also made. Even more importantly perhaps, the teams of the ICNND have sparked an interest in nutrition research in the countries where they have gone. They have provided tangible evidence of their interest in nutrition welfare by leaving behind basic, well-equipped biochemical laboratories in which the native nutritionists can continue the work. Follow-up information and advice is also given to maintain interest and enthusiasm. Our country has certainly reaped much benefit in establishing good will for the relatively small amount of money invested in the work of the ICNND.

In general, physical examiners are pretty well agreed on the standards and findings in frank deficiency diseases. However, it has been found that few, if any, of the physical signs of suboptimal nutrition are easily and uniformly recognized. A combination of the physical findings of deficiency diseases and abnormal biochemical findings of nutrients in blood and serum indicate the results of a poor dietary pattern of long duration. In many of the surveys conducted by the ICNND, it has been observed that the individual examiner's idiosyncracies of definition and interpretation of physical signs lead to the greatest disparity in the clinical interpretation of nutritional status. For this reason, great care must be exercised in standardizing the definition of the clinical signs to be sought.

In these surveys, biochemical analyses are done on the blood and urine of about one of every four or five subjects examined clinically. Blood is evaluated for: serum protein, hematocrit, hemoglobin, serum vitamin A, carotene and vitamin C. Urine samples are analyzed for thiamine, riboflavin and N^1-methylnicotinamide. Special analyses such as cholesterol are done as indicated.

PUBLIC HEALTH INDICES

Another interesting approach to the evaluation of nutritional status is the application of such public health indices as vital statistics and incidence of disease. Since public health deals with the health of the community rather than the individual, public health indices will provide information as to nutritonal and health conditions of large groups of people. This is not a static condition; it is subject to constant change.

Death rates reflect the status of general health rather than nutrition specifically. However, mortality from certain specific diseases such as tuberculosis is generally accepted as being influenced by the nutritional status of the population. Susceptibility to tuberculosis increases as poor nutrition develops. High infant mortality, premature births and still-births in primiparae of poor economic status, toxemia of pregnancy, and elevated mortality of children under 5 years of age have all been related to inadequate nutrition. In a similar way, atherosclerosis and increased mortality from ischemic heart disease are highest in the prosperous over-nourished groups of people.

CLINICAL EVALUATION OF NUTRITIONAL STATUS

The difficulties associated with the clinical appraisal of nutritional adequacy in man, especially the minimal changes that may develop, have been emphasized. In populations where the incidence of inadequate nutrition is high a rapid, clinical evaluation is possible. It yields good results if special attention is paid to the skin, the eyes and the mouth because here one finds the most overt effects of nutrient deficiency. Such important findings as xerophthalmia, night blindness, punctate keratitis, angular conjunctivitis, cheilosis, angular stomatitis and glossitis are well known clinical signs of nutritional deficiency. When these signs are present they indicate a prolonged deficit. This does not imply, however, that equal significance can be assigned to the several signs of deficiency.

BIOCHEMICAL LESIONS OF NUTRITIONAL DEFICIENCY

Lesions mentioned above represent anatomical changes seen in the final stages of the deficiency syndrome. It would be helpful if a deficiency could be diagnosed earlier when perhaps only the biochemical alterations in tissues are present. How much is poor diet reflected by changes in the concentration of chemical substances in tissues and body fluids or by the development of abnormal metabolic patterns or concentration of enzymes? We have some indications that abnormal biochemical patterns do give an early hint of more severe deficiency to follow if an inadequate diet is continued. Biochemical evaluations are expensive, time consuming, and difficult to do "on the spot" in field studies. Samples of blood, serum or urine, however, usually can be sent to base laboratories where adequate biochemical facilities are available.

Protein

Protein nutritional adequacy can be estimated by a number of facets of protein metabolism. For adults, the daily excretion of urinary nitrogen is a fair index of protein intake. Also, the ratio of urea to creatinine in fasting urine samples bears a direct relationship to the level of protein metabolism. The level of free amino acids in the plasma may also indicate the level of protein nutrition. A number of workers have estimated muscle mass, or lean body mass by the 24-hour excretion of creatinine.

Vitamin A

One must rely on serum levels of vitamin A to indicate adequacy of diet for this vitamin. However, although fluctuations of carotene level in the serum tend to reflect recent dietary intakes this is not necessarily so for vitamin A. The ICNND surveys indicate that serum levels of vitamin A between 20-50 mcg.% are acceptable, 10-19 mcg.% are low and below 10 mcg.% indicate a deficiency of vitamin A.

Vitamin E

Of considerable interest has been the recent studies which indicate that high intakes of unsaturated fatty acid, particularly linoleic acid, may make vitamin E a required nutrient for man. Vitamin E deficiency has been reported also in isolated cases in both adults and children, especially when fat absorption is impaired as in cystic fibrosis and steatorrhea. When serum levels of vitamin E fall below 0.35 mg. per 100 ml., there is a high incidence of red blood cell hemolysis on exposure of these cells to dilute solutions of hydrogen peroxide. This RBC hemolysis test, when positive, is considered a good index of vitamin E deficiency.

Ascorbic Acid (Vitamin C)

Serum levels of vitamin C may be zero for a long time before signs of scurvy are seen. It is concluded that serum levels of vitamin C reflect recent intake of

the vitamin. Although a zero serum level of vitamin C is not in itself diagnostic of scurvy, it is compatible with it. There is strong evidence that the concentration of ascorbic acid in white blood cells is a good estimate of vitamin C concentration in tissues generally. This test involves a number of technical difficulties. The chief one is a careful isolation of the white blood cells. An intradermal skin test with 2, 6 dichlorophenol-indophenol may be a useful indicator of the degree of tissue saturation of vitamin C. This test requires careful standardization. It is not specific because the skin contains many reducing substances other than ascorbic acid.

Riboflavin

The most consistent and significant test for evaluating the nutritional adequacy of riboflavin seems to be its concentration in red blood cells. On riboflavin intakes of 0.55 mg. per day for 16 months, the RBC riboflavin content was 10.0-13.1 mcg. per 100 ml., while in individuals taking 2.55-3.55 mg. of ribaflavin per day, their RBC's contained 20.2-27.6 mcg. of riboflavin per 100 cc. In field surveys, the determination of riboflavin in a single fasting specimen of urine may be used to signify the degree of tissue saturation. An excretion in the urine of 150 mcg. per gram of creatinine excreted indicates adequate tissue saturation.

Thiamine

Since thiamine is essential to the metabolism of carbohydrate, pyruvic acid accumulates in the blood during thiamine deficiency. This finding, however, is not consistent and may be in part non-specific. For practical field studies, thiamine excretion in the urine per gram of creatinine excreted seems to provide adequate and reliable information of thiamine nutritional status.

Niacin

Niacin metabolism is influenced by the amount of tryptophan in the diet; 50-60 mg. of tryptophan is equivalent to 1 mg. of niacin in meeting the niacin requirement. Also, niacin is not excreted as such but is metabolized to at least two methylated derivatives. Thus, factors which must be considered in evaluating niacin metabolism are N^1-methylnicotinamide and its 6-pyridone. The amount of these niacin metabolites per gram of creatinine in random urine specimens provides satisfactory information in regard to the dietary adequacy of niacin.

Pyridoxine

In pyridoxine deficiency, one finds a disappearance of pyridoxine acid from the urine, a marked reduction of urinary pyridoxic acid excretion, a reduced ability to convert tryptophan to niacin, and an abnormal production of xanthurenic acid after a test load of tryptophan. The elevation of blood urea after a test load of alamine may also be related to vitamin B_6 nutriture.

Iron

Since iron deficiency anemia is one of the most common deficiency anemias its diagnosis is important. Serum iron levels are low and iron-binding capacity is

elevated in iron deficiency. The bone marrow is devoid of iron and iron deposits such as hemosiderin; this condition may continue even after hemoglobin is returned to normal if the circumstances that led to iron deficiency in the first place persist. Iron deficiency in the adult male or post-menopausal female is highly suggestive of blood loss. It should be searched for with great care.

DIETARY SURVEYS AS A GUIDE TO NUTRITIONAL STATUS

Certainly diet surveys, along with biochemical and clinical studies, are an essential tool in evaluating nutriture. Of considerable interest was a report of an interesting discrepancy between the energy value of the British food supplies and the estimated energy requirements of the population. "In 1956 total food supplies at the retail level were equivalent to about 3,100 calories per head per day, compared with the requirements at the physiological level of about 2,400 calories per head per day, a gap of 700 calories per head per day or a fifth of the food supply." Does this reflect underestimation of physical activity and caloric requirement or an extremely high level of food waste?

A careful record of dietary intake by itself cannot be used to determine nutritional status. However, when the food intake is translated into nutritional units and values and correlated with clinical and biochemical findings, much useful and significant data regarding nutritional status can be obtained.

PROTEINS AND AMINO ACIDS IN NUTRITION

Perhaps no other aspect of nutrition research in the past decade has been so actively pursued as the relation of dietary proteins to health and disease. Two important questions directed to the panel on proteins were: (1) How is man's health adversely affected by the improper quantity and quality of dietary protein and how can the adverse effects be recognized? and (2) What quantities of protein are needed at different ages under varying physiological and environmental conditions in order to have optimum nutrition and health?

CLINICAL RESULTS OF PROTEIN MALNUTRITION

Kwashiorkor is the clinical end result of protein malnutrition, especially of protein of high biological value. *Marasmus* is the clinical expression of general protein undernutrition of a more balanced nature. In technically underdeveloped countries, as population pressure increases and food supplies become limited, the diet consists of more and more starches and cereals and less protein. This sets the scene for the development of protein malnutrition. Vegetable and cereal proteins tend to be deficient in various combinations of either lysine, tryptophan or sulfur amino acids. Skillful blending of various vegetable proteins, cereals, and legumes tends to correct the several individual deficits. The use of foods with high quality proteins such as milk, even in small supplements, also is an effective way to fill in the limiting amino acids of cereal mixtures. No combination of nutrients, of course, will correct the effects of protein deficiency unless a suitable pattern of

amino acids is present. Therefore, caution also must be used to avoid an imbalance of amino acids.

METABOLIC AND BIOCHEMICAL CHANGES IN PROTEIN DEFICIENCY

The clinical picture in Kwashiorkor has been described often and is characteristic enough to make identification relatively easy. It is hoped, however, that improved biochemical and metabolic tests may provide earlier diagnosis.

Alterations in plasma amino acids may be helpful since they are reduced in protein deficiency. In fact, the most limiting amino acid of the protein may be identified by a fall in the plasma level of that amino acid only.

Serum and urine urea levels are reduced in protein deficiency and are indicative of a reduced protein intake, but not necessarily a state of protein deficiency.

Although hypoalbuminemia is a reflection of protein deficiency, the clinical picture of protein deficiency also may become evident at or near the time that serum albumin falls significantly. This limits the value of serum albumin in the evaluation of early deficiency. Thus, one must give greater consideration to "marginal hypoalbuminemia" as an early clue to deficiency.

THE CONCEPT OF THE PROTEIN RESERVE

Much discussion was directed toward the significance of the protein reserve. The idea that protein adequacy may not be determined by nitrogen balance alone generally is appreciated now. The amount of protein needed for maintaining nitrogen balance must vary with physiological conditions; it increases with the magnitude of the protein reserves and the size of the labile nitrogen pool. There is a dynamic equilibrium between the cellular proteins and the non-protein labile nitrogen pool, made up primarily of amino acids. Cellular proteins are derived from the metabolic pool of amino acids during growth and repair of tissues, and in turn, cells contribute amino acids to the general amino acid pool if the diet is deficient in protein. Since the cellular proteins are part of enzyme systems, alterations in enzyme activity may reflect a decrease in protein reserves. This may occur when demands are made upon the cells to contribute to the labile metabolic pool of amino acids. There is a biological priority system for the synthesis of body proteins. Such tissues as muscle and liver serve as a large source of reserve protein to provide amino acids for the synthesis of other proteins of higher priority value. It also should be noted that the nitrogen contributed by non-essential amino acids will aid in the retention and utilization of essential amino acids in protein anabolism by the body.

RETENTION OF DIETARY NITROGEN

Of considerable interest is the observation that nitrogen is retained in part in the body when the intake of protein exceeds the minimum requirment. This increase in nitrogen retention in the adult is not necessarily accompanied by an

increase in body weight; it has been termed "adult growth." This may be reflected by increases in the protein reserve.

It is most difficult to evaluate the exact nature and extent of the protein reserve. No one can doubt its significance to optimal nutrition and health, however. The protein reserve is certainly not a depot or packet of easily identifiable material such as body fat, or tissue glycogen. Each cell, especially the cytoplasm and its supply of enzymes, probably is the site of protein reserve. In the face of stress or protein undernutrition, the cell must contribute from its reserve of protein until it is down to an irreducible minimum which is not easy to define.

In individuals in negative nitrogen balance, where protein reserves of cells would be called on to contribute amino acids, a much higher excretion of riboflavin is noted. The association of this increased riboflavin excretion may indicate that the labile protein stores in the cells are largely flavoproteins and are the first to be expendable when tissue protein catabolism is increased. This also is reflected in decreased activity of certain enzymes, especially in liver tissue.

Cytoplasmic protein, including ribonucleo-protein, is lost promptly from certain tissues during starvation or a protein-free diet. On the other hand, loss of nuclear protein, such as DNA, is minor.

If protein reserves are inadequate, the body is unable to react promptly and properly to the stress of infection or trauma. Therefore, the extent to which protein reserves are increased provides a gauge of optimum protein nutrition.

VEGETABLE PROTEIN MIXTURES FOR HUMAN CONSUMPTION

It is well known that the protein deficiency syndrome can be treated and prevented by adequate dietary protein. However, a basic question which confronts nutritionists is: How can this be done considering the tremendous scope of the problem and the economics involved? The supply of high-quality animal protein needed at a reasonable cost is just not available to millions of people involved.

INCAP in Latin America has worked toward a very intelligent and practical solution of this problem by developing a low cost, practical and acceptable vegetable protein mixture suitable for human feeding. INCAP's vegetable mixture 9B, with a protein content of 27.5%, contains 29% whole ground maize, 29% whole ground sorghum grain, 38% cottonseed flour, 3% torula yeast, 1% $CaCO_3$ and 4,500 I.U. of vitamin A per 100 gm. It is called INAPARINA. Used as a thin gruel, it has been tested and found acceptable in Central America. It may do much to alleviate the problem of protein malnutrition.

ADULT PROTEIN REQUIREMENT

Further evidence that nitrogen balance is unsatisfactory for determining optimum protein requirement was evident from studies reported from Japan. Adult human subjects were fed diets low in protein but adequate for nitrogen balance. After the relatively short time of 2 weeks, hemoglobin, total circulating blood and erythrocyte count started to decrease. Signs of the mild protein defi-

ciency were an increased volume of extracellular fluid and the development of slight edema.

Studies also were reported which might require a revision of the idea that work is not done at the expense of muscle protein. It was found that increased exercise for a ten-day period on a low-protein intake which still provided positive nitrogen balance resulted in anemia, red blood cell destruction, and hypoproteinemia. The unfavorable findings could be prevented by increasing the protein intake. These observations are most interesting and should stimulate further work in this area.

LIPIDS IN HEALTH AND DISEASE

The past decade has seen an almost overwhelming amount of research activity and published reports directed toward the solution of the alarming increases in deaths from ischemic heart disease. Much of the work has provided evidence to implicate disorders of lipid metabolism, particularly those resulting from improper diet. For the most part, the dietary fault has been laid to an imbalance with regard to the amount of fat calories in the diet, and more specifically, the overuse of saturated or "hard" fats. While diet and a disordered fat metabolism can explain both the biochemical and epidemiological features of atherosclerosis and ischemic heart disease, these factors are not universally accepted.

Ample evidence is at hand to support a statistically significant relationship between increased incidence of atherosclerosis and elevated levels in the blood of cholesterol and β-lipoproteins. There also is a significant relationship between diet and serum cholesterol levels. Unfortunately, it has not been shown that the dietary effects on serum lipid levels have any bearing on the degree of atherosclerosis or whether atherosclerosis and ischemic heart disease bear a cause and effect relationship.

Although it is generally accepted that occlusion of the coronary vessels with infarction is due to atherosclerosis, this may not be correct. A great number of cases with myocardial infarction are brought to autopsy with no evidence of a subtending coronary artery occlusion. While the incidence of ischemic heart disease has increased, it is claimed that the incidence of atherosclerosis has really *declined*. Thus, a factor in addition to atherosclerosis may ultimately explain this seemingly paradoxical observation.

THE ATHEROMATOUS PLAQUE

The villain in atherosclerosis is the plaque which narrows the lumen of the blood vessel to the point of occlusion. Since there is fibrosis of the intersial lining of the blood vessel wall to which the lipid plaque is tightly adhered, it is natural that lipids and fibrin are considered etiologically in the formation of the plaques. Certainly, cholesterol and its esters are found in high concentration in the plaque and there has been demonstrated a high affinity of fibrin for cholesterol and some of its fatty acid esters.

SERUM LIPIDS IN ISCHEMIC HEART DISEASE

Three lipid types seem to be associated with differences in serum lipid levels between control subjects and those with ischemic heart disease. These are cholesterol and its esters, phospholipids and proteins in the form of lipoproteins, and neutral fat or tri-glycerides. Considerable controversy has existed concerning which of these factors is most reliably associated with an increased incidence of atherosclerosis. Since cholesterol is much more easily determined, most attention has focused on it and certainly it is increased significantly in groups with a high incidence of ischemic heart disease as compared to controls. Much the same can be said for β-lipoprotein which is a lipid carrier. When a high-fat test meal is fed to patients with ischemic heart disease, they have a more intense and prolonged lipemia than matched controls. It is not clear whether this is due to impairment of the heparin clearing mechanism or to an increased rate of fat absorption. It is interesting that anginal pain may be made worse during the lipemic phase. It has also been suggested that lipemia alters the blood clotting mechanism and depresses the fibrinolytic activity after a meal.

DIET FAT AND SERUM LIPIDS

It is now well established that diets high in a fat or oil primarily of saturated fatty acids composition raises blood cholesterol levels and that these levels may be lowered by changing the diet to include a high content of polyunsaturated fatty acids. No one knows the mechanism of this effect. Exogenous cholesterol may augment the elevation of cholesterol by dietary fat since egg yolk, for instance, a potent elevator of blood cholesterol, actually has a fairly high iodine number and contains from 16 to 19% of linoleic acid.

The only other dietary factor which alters blood cholesterol appreciably is nicotinic acid. It produces sharp drops in serum cholesterol levels. Pronounced flushing and pruritis may accompany its use, however. Diets very high or very low in protein, apparently do not significantly alter the serum cholesterol level following the feeding of fat.

While the total fat content in our diet may not have changed significantly in the last twenty-five years, there has been a decreased consumption of polyunsaturated fatty acids with an increased intake of saturated fatty acids. This is reflected in a progressive decline in the use of whole grain cereals and fish and an increased use of hydrogenated fats and oils.

ENDOCRINES IN HUMAN METABOLISM

Hormones may play a role in the alteration of serum lipids and thus influence the incidence of atherosclerosis. This is manifested by the marked sex difference in incidence of ischemic heart disease between pre-menopausal females and adult males.

Changes in blood cholesterol concentration may be the result of changes in the rate of cholesterol synthesis or degradation. Removal of the ovaries from

females results in increased plasma cholesterol levels. Is this due to alterations in synthesis or destruction of cholesterol? Animal studies indicate that estrogens (ovarian hormone) tend to increase cholesterol synthesis, but decrease its biological half life. Therefore estrogens accelerate the turnover of plasma cholesterol and effect an overall lowering of the level of circulating cholesterol. In males, synthetic estrogen (stilbesterol) produced significant lowering of plasma cholesterol and markedly reduced the biological half life of cholesterol.

The thyroid and adrenal cortex as well as the gonads exert important influences on the rate of cholesterol synthesis and degradation and hence the plasma cholesterol levels. These factors, in addition to the intricacies of lipid metabolism, emphasize the complexity of the problem of atherosclerosis.

THE PRESENT STATUS

Research work has brought into sharper focus the role of lipids in atherogenesis, especially the effects of saturated and polyunsaturated fatty acids in this regard. Yet, it was the concensus of the experts on this panel that it would be unwise at this point to make broad recommendation of diet alterations that would affect the population as a whole. Perhaps this is wise. Some others feel that some changes in the diet could and should be made which would *permit* an increased intake of polyunsaturated fatty acids.

NUTRITION IN MATERNAL AND INFANT FEEDING

If pregnant women follow the recommended dietary allowances as a guide during the second half of pregnancy, a very large number of them must be considered to be on a deficient diet. Yet, babies are being born in great numbers and fed from the breast if this is desired by the mother. It is certainly difficult to interpret the needs of the pregnant woman on the basis of what the non-pregnant woman requires. There are, of course, minimal requirements for various physiological needs, including pregnancy. Nutrient intakes below these minimum requirements bring harm to the mother or foetus or both. Above the level of maintenance, the pregnant woman can adapt amazingly well to a wide range of nutrient intake. Optimum nutrition in pregnancy and, in fact, nutrition generally, is yet to be defined. One must consider that while the body can adapt to varying nutrient intakes above the minimum, the homeostatic mechanisms that effect this adaptation may be over-stressed with an ultimate failure in health.

THE DIET OF THE INFANT

Milk is the basis of infant diets and is a food characterized by its high fat content. Breast milk for example supplies 61% of its calories as fat, while undiluted cows milk has about 50% of its calories in the form of fat. Diluted cows milk in many formulae may provide 30% of the total calories as fat. Of considerable interest is the fact that almost all the weaning diets, other than animal milk, are based on animal broths, cereals, root crop and vegetable purees

which contain very little fat. An infant seems to tolerate well and thrives on a high fat diet. Such diets of relatively high calorie density may help in making the protein present more available for purposes of anabolism and prevents their waste as a source of calories.

HUMAN MILK

Human milk is endorsed as the food of first importance for the human infant. Many arguments support this idea. Breast feeding reduces both mortality and morbidity and infants fed human milk demonstrate a higher resistance to intestinal disorders and respiratory diseases. This is true despite the fact that transfer of immune bodies from ingested human milk through the intestine into the blood is negligible. Most importantly, however, is the observation that human milk produces an acid reaction in the intestinal tract and the intestinal flora has a prevalence of *Lactobacillus bifidus*. These are gram positive rods. Human milk, but *not* cow's milk, contains a growth factor essential for *Lactobacillus bifidus*. This growth factor is not destroyed by autoclaving. While its exact chemical nature is not known, it apparently belongs to a group of nitrogen containing carbohydrates. It may be related to the neutral or acidic oligo- and polysaccharides in human milk. These substances seem to be a special feature of human milk.

Despite the advice of many pediatricians, breast feeding is not particularly popular. It is practiced only by 12 to 25% of the mothers in the United States.

COW'S MILK VS. HUMAN MILK

In this country most babies are fed cow's milk formulae. Recent clinical experiments with infants, conducted by De Mayer, show that the protein biological values for infants are 87 for cow's milk and 100 for breast milk. Because of the higher protein content of cow's milk, many infants fed cow's milk seem well fed, grow well and have a low morbidity due to dietary causes. However, to ease the work load of the infant's underdeveloped kidneys, commercially modified milk formulae, such as Bremil®, in which the protein content is adjusted to make the amino acid content similar to that in breast milk, are available. This modification permits the reduction of total protein fed from 3½ to 1½% and thus reduces the work load for the infant's kidneys.

Cow's milk is much higher in its protein and ash content than is human milk. The protein quality of the two milks, however, is essentially the same.

Cow's milk more easily than human milk supplies the amount of protein (3.5 gms./Kg.) formerly recommended by the Food and Nutrition Board of the National Research Council. Is all of this protein needed? Is it so important to strive for the maximal growth rates in babies so eagerly boasted about by doting parents? Certainly the protein level of 3.5 gm./Kg. of body is too high or else human milk must be considered a sub-standard nutritional product unless gross overfeeding is practiced.

MATURATION OF INFANTS

Newborn infants, especially premature infants, do not have fully developed enzymatic equipment and also some of their organs are not fully developed. The underdeveloped kidneys of infants during the first four to six months have reduced concentrating ability. Thus, they may handle with difficulty the larger loads of protein and mineral waste products provided by cow's milk. This necessitates water supplementation for infants fed unmodified cow's milk formulae during hot spells, or in febrile states. The solute and metabolite load then will be presented to the kidney in a more dilute form.

THE FUTURE AND THE CHALLENGE FOR NUTRITION

It is quite clear that the tools used for research in nutrition are changing. The era of diet feeding experiments with animals by which new vitamin and other nutrient discoveries were made is pretty much in the past. This was certainly a golden age of nutrition. This does not mean that research with the whole animal is at an end; indeed, it should be emphasized that more animal studies are needed for a better understanding of how the many nutrients function in the integrated scheme of metabolism. The final test of a nutritional concept will continue to be in the intact animal. The research approach, however, must include more and more emphasis on biochemistry and enzymology to better elucidate the chain of metabolic reactions. Isotopes and other physical chemical tools must be employed to bring new insight to the problems of biochemistry. As more information becomes available through greater application of biochemistry, physical chemistry, physiology and the newly appreciated and powerful force of genetics, greater quantitation and predictability will develop in the science of nutrition. The training of students today in nutrition must include greater emphasis on these other areas of science.

It would seem that the main, long-range goals of nutrition are to insure better health and productive, effective longevity for man insofar as better food and diet practices can be employed to do this.

Good nutrition must be based on a sound, productive agriculture that can provide a continuing and varied supply of foods in an abundance sufficient to meet all needs. Coupled to this agriculture program must be an industrialized system of food processors and manufacturers who can take the raw food supply and convert it into finished products of high quality, palatibility and wholesomeness. These products must be conveniently and widely distributed and made available at a price within reach of the great mass of consumers. It is evident that agriculture and the food industries involve a very large segment of our economy. Perhaps nowhere in the world is this phase of economy so effective as here in the United States. A visit to any grocery store will testify to the variety and abundance of our food supply. However, this alone does not insure good nutrition.

In a practical sense, good nutrition must be generated in the kitchen and practiced at the table. Care based on sound nutritional knowledge must be exercised by the housewife in the selection and preparation of food, quite a large

responsibility. Prudence also must be used at the table, especially by those inclined to be overweight. Malnutrition in the form of overnutrition is the curse of abundance of the food supply when accompanied by a lay public inadequately educated about nutrition and health. Of course, even the knowing may be greedy, and greed, unfortunately, is a common human failing. Good nutrition practice is such an easy thing to postpone until tomorrow, especially when today's meals are so abundant and tasty.

There is a great need for a better and more direct approach to the problem of public education in matters of nutrition and health. Unhappily, the fringe pseudo-scientists and food faddists do a much better job than bonafide nutritionists, physicians, dietitians, or home economists in capturing the interest and following of the public. We must face the fact that, as scientists, so far we have been most incompetent in translating and communicating the knowledge about nutrition to Mr. and Mrs. America. Careful thought and action must be developed to change this situation or the public will continue to put the quacks on the best seller's lists. The Nutrition Foundation and the Council on Foods and Nutrition of the American Medical Association have given serious consideration to this problem. It is hoped programs will be developed to correct this very bad situation.

Nutrition is not only a public health problem concerned with groups of people; it also is a highly individual and personal matter influenced by all of man's idiosyncracies plus the acquired and genetic factors that governs his actions and attitudes. Nutrition is aimed primarily at preventive medicine and keeping people well. Every sick person, however, is an individual problem in which the nutrition factor can become important in medical management.

The doctor must be depended upon to supply the knowledge and judgment about sound nutrition practices to aid in the care of the sick and in recovery and rehabilitation after illness. How adequately are our doctors being trained in nutrition during the course of their medical education? How well do they answer their patient's questions about nutrition? What is their knowledge of nutrition? How well do they apply available nutrition knowledge in the care of the sick? It is difficult to give adequate answers to these questions. To my knowledge, no one has in any formal manner indicated the scope of knowledge about nutrition that a graduating medical student should know. Nor has an extensive evaluation been made of the practising doctors' knowledge of nutrition. Unfortunately, both courses in nutrition and doctors with an interest and special training in nutrition are rather rare in medical schools.

Many teachers of medicine, particularly in certain sub-specialties such as metabolism and gastroenterology, are seriously concerned with the importance of nutrition and emphasize it to students. In the clinical years of medical training, one perhaps should not be too concerned about the presence or absence of formal courses in nutrition or, for that matter, any other scientific discipline.

Nutrition may be taught best in the medical wards by the skillful use of the solid base of medical education — a patient, a student, and a teacher. It depends on the ability of the teacher to try to interpret and understand disease

based on the fundamental concepts of nutrition, biochemistry, physiology and pathology. Here is where basic sciences can be brought to life and made a dynamic force for the student of medicine. This is the time, often with great regret, the student realizes that he spent too little time on the basic sciences in the first two years of medicine.

There is a strong force in American medicine today which stresses the importance of nutrition in medical education and research. It is evidenced by the recent formation of the American Society of Clinical Nutrition, a division of the American Institute of Nutrition. It is hoped that this group will help to place nutrition in proper perspective in our medical training programs.

To translate nutrition knowledge into practice, the doctor must make greater use of the hospital dietitian. The dietitian should accompany the staff on working ward rounds to provide information about special diets and how much the patient is eating, and to suggest diet therapy that might be helpful in the patient's care. Too often, the dietitian is asked to interpret and fill such vague orders as: "a low caloric diet," "an ulcer diet," "a gall-bladder diet" etc. Diet orders should be written by the doctor just as specifically as he would prescribe digitalis or other drugs.

Finally, better solutions must be found to rectify the great world paradox of malnutrition resulting from overeating of an abundant food supply on one hand, and marginal or sub-marginal nutrition due to a limited, monotonous, protein-poor food supply on the other hand. Here nutrition is a global problem involving millions of people. In fact, the life and stability of our free and democratic society we know and love may depend on how well we are able to bring the technically underdeveloped countries to a higher plane of nutritional adequacy. A starving or underfed family is much more interested in food than political ideology. It will turn in the direction which presents a solution to the food problem. The challenge of the poorly fed millions may well be a greater challenge than outer space. If the food problem is not solved, outer space may be all we have left.

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